Galileo's Europa Polar Region Observations By The Near Infrared Mapping Spectrometer (NIMS) and the Ultraviolet Spectrometer (UVS). D. Matson[2], A. Ocampo[2], W. Smythe[2], R. Carlson[2] ,the NIMS Team , A. R. Hendrix[1], C. A. Barth[1], C. W. Hord[1], A. L. Lane[2], and the UVS Team; ([1]Laboratory for Atmospheric and Space Physics, University of Colorado; [2]Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena California, 91109, USA.)

Joint observations of Europa with the Galileo Near Infrared Mapping Spectrometer (NIMS) and the Ultraviolet Spectrometer (UVS) were obtained in Galileo's fourth orbit about Jupiter to study spectral variability over a wide spectral range. NIMS spectral range is from 0.7 to 5.2 microns, while the UVS data considered here spans the range of 2000 to 3200 Angstroms (F-channel).

Galileo's fourth orbit provided an excellent opportunity to obtain high spectral and spatial resolution data of Europa. These observations cover the polar and high latitude regions of Europa as shown in figure 1. The observations were named SUCOMP01, 02 and 03 (for SUrface COMposition) indicating the main objective of the observation; which was to determine surface spectral variations at high spectral and spatial resolution. The NIMS obtain all observations at its highest spectral capability of 408 wavelengths. SUCOMP01 covered a portion of the southern polar region of Europa (center coordinates: latitude -50 degrees and W. longitude 306 degrees) with a phase angle of 59 degrees at a resolution of 9 kms. SUCOMP02 covered a portion of the northern polar region (center coordinates: latitude 32 degrees and W. longitude 300 degrees) with a phase angle of 58 degrees and a resolution of 10 kilometers. SUCOMP03 covered the northernmost latitudes for this orbit (center coordinates: latitude 55 degrees and W. longitude 315 degrees) with a phase angle of 70 degrees and a spatial resolution of 2 kilometers. The SUCOMP01 observation covered a region of visibly light-colored ice, while the SUCOMP02 observation measured dark-colored ice. The SUCOMP03 observation covered a transition region between light and dark ice. The UVS field of view (FOV) footprint was 30 km x 118 km during SUCOMP01 and 51 km x 204 km during SUCOMP02.

The spectra of Europa shows an expected dominance of water ice. There is evidence for other contributions to the spectrum, in particular a component attributable to a hydrated mineral phase [5]. There are significant albedo variations in the infrared. For the near infrared (0.7 microns) these variations show patterns similar to the Voyager visible maps. However noticeable differences are observe. In general, we find that the SUCOMP02 region, which consists of visibly dark ice, is also dark in the ultraviolet. For 3100-3200 Angstroms the light ice (SUCOMP01) and dark ice regions have a similar albedo. The albedos of both regions decrease between 3100 and 2600 Angstroms, with the dark ice albedo having a redder slope than the light ice. The dark ice possibly has an absorption feature centered at 2800 Angstroms.

We find that the light ice region is somewhat brighter than the disk-integrated albedo measurement of Europa centered at 315 degrees longitude (from the second orbit). The dark ice is similar in magnitude to the disk-integrated 315 degrees. longitude albedo, with a slight reddening at 3100-3200 Angstroms. This indicates that the dark ice, covering the majority of the central latitudes of Europa's trailing hemisphere, dominate the disk-integrated trailing hemisphere observations.

The trailing hemisphere of Europa is constantly bombarded by Jupiter's co-rotating magnetospheric particles. Consequently, the ratio of the trailing hemisphere albedo to the leading hemisphere albedo indicates a broad band centered at 2800 Angstroms that has been measured by IUE [2,3], HST [4] and the Galileo UVS [1]. The band is presumed to be due to magnetospheric sulfur and oxygen ions interacting within the ice lattice in Europa's surface. Because these are the first-ever disk-resolved ultraviolet data of Europa's surface, we may use the data to determine how the absorption band varies across the surface of the trailing hemisphere. We may also determine how the ultraviolet absorption features vary as the ice grain size (as determined by NIMS) varies over the surface.

The darkness of Europa's trailing hemisphere may be due solely to the magnetospheric particle bombardment, which tends to darken and redden surfaces. Another possibility is that material has seeped from Europa's interior through cracks on the icy surface; this material may have been dark to begin with, or may have been darkened and reddened by ion bombardment. Highly resolved measurements of the dark ice on Europa will help in determining the source of the darkness.

References:

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